

Thermal Infrared Observations of Active Ocean Entry Sites at Kilauea Volcano, Hawaii

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A common feature of the current eruption of Kilauea Volcano is the development of lava tube networks that transport molten lava from source vents to the Pacific Ocean with little loss in temperature. The entry of molten lava into the ocean can create shallow hydrothermal plumes that extend up to 2 km off shore. The plumes are typically bifurcated, with hot surface water separated by roiling masses of cooler water driven to the surface by the heat released from submarine lava flows.

We have acquired thermal infrared image data over two active entry sites. The most recent data were acquired over an entry near Lae Apukion 10 April 1993. These data, acquired from a helicopter with a thermal infrared video camera, provide a detailed look at the dynamic surface temperature patterns associated with the roiling water mass.

We obtained a more extensive data set over an entry site near Kupapau Point in September and October 1988. These data, acquired with NASA's airborne Thermal Infrared Multispectral Scanner (TIMS), depict a large portion of the Kupapau flow field in addition to the ocean entry site. We have used the TIMS data, together with field observations compiled by the USGS Hawaiian Volcano Observatory, to relate the activity at the entry to activity on the rest of the flow field.

TIMS image data acquired on 30 September and 1 October depict a bifurcated hydrothermal plum originating from the entry site. A third hot lobe appears at the junction of the original two in an image acquired on 2 October. The appearance of this central lobe roughly coincides with a series of large littoral explosions at the entry on the night of 1 October. An image acquired on 3 October depicts three hot lobes in the hydrothermal plume and a fresh breakout of lava on the surface of the flow field. This breakout originated ~4.5 hours after the 2 October TIMS overflight. The surface activity had stagnated by 5 October, the same day that a series of large littoral explosions were observed at the entry. The final TIMS image, acquired on 11 October, shows that the central hot lobe of the hydrothermal plume had disappeared. The flow of lava into the ocean had been heavy between 5 and 11 October.

The littoral explosions may have resulted from the entry of sea water into the distal end of the lava tube, while the appearance of the central hot lobe in the hydrothermal plume may indicate a reduction in the amount of heat provided by the submarine lava flows. These phenomena could be explained by a reduction in the volume of lava supplied to the ocean entry; a hypothesis supported by the onset of surface activity. The supply of lava was apparently restored by 11 October 1988.

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